

REPORT

OF

THE SECRETARY OF WAR,

WITH ONE FROM

THE ENGINEER DEPARTMENT,

On the practicability of an Outlet from Albemarle Sound to the Ocean, &c.

FEBRUARY 23, 1829.

Referred to the Committee on Commerce, and ordered to be printed.

DEPARTMENT OF WAR,

February 21st, 1829.

SIR: In obedience to a resolution of the Senate, of the 4th instant, I have the honor of transmitting, herewith, the report of "a survey made by the United States' Engineers, in pursuance of a resolution of Congress, to ascertain the practicability of opening an Outlet from Albemarle Sound to the Ocean, at or near the former site of Roanoke Inlet; and, also, the report made some years ago to the same Department, upon the same subject."

I am, very respectfully,

Your obedient servant,

P. B. PORTER.

To the PRESIDENT

Of the Senate of the United States.

REPORTS OF MR. FULTON

TO THE

Board of Internal Improvement of North Carolina.

REPORT*

On the practicability of opening a communication from Albemarle Sound to the Atlantic Ocean, to the President and Directors of the Board for the Internal Improvement of North Carolina, by

HAMILTON FULTON,

Civil Engineer to the State.

Raleigh, September 15th, 1820.

GENTLEMEN:

On the 14th of March I proceeded from Edenton to Roanoke Island, for the purpose of examining into the practicability of opening an outlet from Albemarle Sound to the Atlantic Ocean.

Previously to my leaving Raleigh, I was furnished with a copy of a map of Roanoke Island and the Sounds, made by a Captain Clarke. On comparing this map with the objects it was intended to represent, I found it so incorrect and imperfect as to be under the necessity of making a new survey, to afford me data from which I could enter into an investigation of the subject with that minuteness its importance required.

Before entering into that part of the report which more immediately falls under my professional department, it may not be improper to notice an opinion which generally prevails, of Sir Walter Raleigh and his fleet having entered Roanoke inlet, at the time the colonization of North Carolina was first attempted.

I have been kindly favored by several gentlemen of this State with the following authorities, viz: a reprint of "the true travels, adventures, and observations of Captaine John Smith," "An Anonymous history of Virginia," (Stith's,) "Williamson's history of North Carolina," and "Wimble's Chart of the Coast of North Carolina, of 1738."

The principal facts related by Stith and Williamson, connected with the subject now under consideration, seem to have been taken from Smith, and dressed in the phraseology of their own times. I shall therefore confine my extracts to such statements in Smith as tend to confirm an idea I entertained of Sir Walter Raleigh never having been personally on the coast, and that neither his fleet nor the fleet of any other adventurers entered Roanoke inlet.

The only mention made of Sir Walter Raleigh is in the two following quotations. The first in page 80: "Upon all those relations and inducements, Sir Walter Raleigh, a noble gentleman, and then in great esteeme, undertooke to send to discover to the southward. And though his occasions and other

* This report (which was published last year,) is reprinted by the Board, in order that the whole matter which relates to opening the proposed new outlet from Albemarle Sound, may appear together.

employments were such he could not goe himselfe, yet he procured her Majestie's letters pattents, and perswaded many worthy knights and gentlemen, to adventure with him to finde a place fit for a plantation." And the second in page 99, at the beginning of a chapter, entitled "How Sir Richard Grenville went to relieve them," it is said —

"In the yeare of our Lord 1586, Sir Walter Raleigh and his associates prepared a ship of a hundred tun, fraughted plentifully of all things necessary, but before they set sayle from England it was Easter. And arriving at Hatorask, they after some time spent in seeking the collony up in the country, and not finding them, returned with all the provision again to England.

"About 14 or 15 days after, Sir Richard Grenville, accompanied with three ships well appoynted, arrived there. Who not finding the aforesaid ship, according to his expectation, nor hearing any news of the collony there seated and left by him as is said 1585, travailing up and downe to seeke them, but when he could heare no newes of them, and found their habitation abandoned, unwilling to lose possession of the country, after good deliberation he landed fiftie men in the Ile of Roanoak, plentifully furnished with all manner of provision for two yeares, and so returned for England."

The first of these quotations states clearly that Sir Walter Raleigh did not accompany the expedition, and the second speaks so ambiguously, that it is problematical if he ever were any thing else than the active promoter of these discoveries.

There is nothing said in Captain Smith's life to support the opinion that any of the fleet or ships entered Roanoke Inlet. By the following extracts, I am inclined to think they anchored somewhere else.

In page 83, it is said, "Captain Philip Amidas and seven men went to Roanoke Island, 7 leagues from the inlet where we entered." According to the scale from which Captain Smith's map is laid down, this must have been Hatteras Inlet. No dependance can be placed on the proportions of this map, as the whole coast, from the southward of Cape Fear to the northward of Cape Henry, is included between 35° and 37° of north latitude.

That there have never been more good inlets on the coast of North Carolina, than those existing at present, is, I think, pretty certain, for in page 85, speaking of the islands and sounds, it is said, "those isles lye 200 myles in length, and between them and the mayne a great long sea, in some places 20, 40, or 50 myles broad, in other more, somewhere lesse, and in this sea are 100 isles of divers bignesses, but to get into it you have but 3 passages, and they very dangerous."

Sir Richard Grenville says, in page 90, "I conclude a good mine or the south sea will make this country quickly inhabited, and so for pleasure and profit comparable with any in the world, otherwise there will be nothing worth the fetching. Provided there be found a better harbor than yet there is, which must be northward if there be any."

Owing to a conspiracy formed by the Indians for the destruction of the colony, Governor Layne was under the necessity of dispersing his officers and men, to preserve them from massacre or famine. Captain Stafford was sent to Croatan to avoid those evils, and keep a look out for vessels of relief. He had only been there seven days, when he descried a fleet of twenty-three sail, under the command of Sir Francis Drake. In page 92, Governor Layne says: "He appointed me a ship of seventy tuns, with an hundred men, and foure moneths victuals, two pinnaces, foure small boats, with two sufficient masters, with sufficient gangs. All this being made ready for me,

suddenly arose such a storme, for foure days, that had like to have driven the whole fleet on shore. Many of them were forced to the sea, whereof my ship, so lately given me, was one, with all my provision and company appointed.

"Notwithstanding, the storme ceasing, the Generall appointed me a ship of one hundred and seventy tuns, with all provisions as before, to carry me into England the next August, or when I had performed such discoveries as I thought fit; *yet they durst not bring her into the harbor, but she must ride in the road.*" It is evident the Croatan here alluded to, is not that part of the country which now bears the name. If it had, it would have been a most improper situation to send a look-out party to. This is further confirmed in p. 103.

"The 20th March (1589,) three ships went from Plimouth, and passed between Barbary and Magadora to Dominico, in the West Indies. After we had done some exploits in those parts, the third of August we fell in with the Low Sandy Isles, westward of Wokokon; but, by reason of ill wea her it was the 11th ere we could anchor there, and on the 12th we came to Croatan, where is a great breach in thirty-five degrees and a halfe, in the north-east poynt of the Isle. [By referring to the map above mentioned, it appears this must have been either Old Topsail Inlet, or Ocracock.] The 15th we came to Hatorask, in thirty-six degrees and a terse, at four fadom, three leagues from the shore, where we might perceive a smoake at the place where I left the colony, 1587." And still farther confirmed by Mr. White, when he found the island of Roanoke deserted, and the word Croatan carved on a post. In p. 104 he says: "It did much comfort me that I did know they were at Croatan. So we returned to our ships; but had like to have bin cast away by a great storme that continued all that night

"The next morning we weighed anchor for Croatan," &c. Had Croatan been the place at present known by that name, what necessity would there have been for weighing anchor?

By Wimble's map, it appears to me, the ports of this State are relatively in the same condition now as they were at the time his survey was taken. On this map is significantly shown a ship bound into the Cape Fear, another into the harbor of Beaufort, a brig into Ocracock, and a sloop into Roanoke; and his sailing or pilot instructions, says, this Inlet [Ocracock] is as good for the navigation of Albemarle as Pamlico sounds.

Although I have felt it my duty to insert the above extracts in this report, it is not with a view of exciting a supposition that the re-opening of Roanoke inlet is impracticable, or that an inlet cannot be made and maintained of sufficient capacity for the existing trade: it is merely to prevent the sanguine expectations of those who may conceive it possible to have an inlet capable of receiving vessels of any draught of water. In Wimble's map there are soundings given at Roanoke Inlet: by those it appears there were then four fathoms at the entrance between the banks. On the outside of the banks there were nine feet water, and at one place in the Roanoke sound only six feet water.

From the earliest accounts we have of the coast of North America, Roanoke is always described as an island; so that the cause, which ultimately closed the inlet, existed in some degree in those times. The waters of the Albemarle sound, not having the rise of the tides of the ocean to contend with in passing into Pamlico sound, opened the communication between the two sounds wider and wider, until the reflux water through the inlet became so weak as to be unable to keep it open. The gradual closing of the inlet

was, no doubt, facilitated by the southerly current, which is said by Wimble to set along the shore at the rate of one knot an hour. This current, I apprehend, had the effect of depositing sand on the north side of the mouth of the inlet; thereby slowly, but progressively, shifting its bed from its original site, near Nay's Head, to the place where it finally closed up, about a mile and a half to the southward.

There are people now alive on Roanoke Island, who remember the passage between Albemarle and Pamlico sounds being confined to what is still called the ship channel. Since that time another channel has gradually opened, which is now one mile and a quarter in width, with soundings in some places twenty-four, and others thirty feet deep. This circumstance plainly shows the effect of the waters passing and repassing through the marshes. It became a matter of course, as these channels increased in width, so did the quantity of water issuing into the sea by the inlet decrease in a proportionate degree.

The level of the surface of the water in the Roanoke sound, is equal to the half tide in the ocean; or, in other words, it is two and a half feet above the level of the sea at low water neap tides, and two and a half feet below the level of the sea at high water.

It is generally supposed there exists in the lower end of Albemarle sound a regular ebbing and flowing of the tide. As far as my observations went, I could not discover any elevation or depression of the waters, except such as were immediately caused by the winds, or the precursor of a wind from a certain quarter, although a light breeze prevailed at the time from a contrary direction; a circumstance which is frequently to be met with at sea. I am of opinion no tide exists here but those termed "leeward tides."

It is likewise supposed there is a continual current from the Albemarle to the Pamlico sound: but this supposition I believe to be unfounded, as the currents are generated by the same cause as the rising and falling of the waters. I have little doubt but in long dead calms a current is perceptible, by the upland waters passing off from the Albemarle sound. During the time I was employed on this survey, (from the middle of March to the beginning of May,) the weather was so boisterous that I had no opportunity of examining the currents during calm weather. It appeared to me the velocity of the current was proportionate to the velocity of the winds. It is likely the current is somewhat stronger from Albemarle sound during a northerly wind, than it is from Pamlico sound during a southerly wind (supposing them to be of equal velocity,) from the land waters being penned during the prevalence of the southerly wind.

A moment's consideration will convince any one there cannot be either an influx or reflux tide in Albemarle sound, or any strong prevailing current from it. It has been before stated, the sound water is $2\frac{1}{2}$ feet higher than the low water of the ocean. The waters of Albemarle sound empty themselves into the sea at Ocracock Inlet, a distance of at least 60 miles. Supposing the water of the ocean to remain stationary at low water, this fall of half an inch to a mile would be barely sufficient to keep the water in motion. The narrowness of the space through which the tide waters at Ocracock bar have to pass, the great expanse over which they have to spread, and the remoteness of Albemarle sound, render it impossible that its surface can be at present influenced by lunar tides.

South-westerly winds produce the greatest elevation of the waters in Albemarle sound, and north-easterly winds the greatest depression. The

extreme difference of level, by the strongest of these winds, during my stay, was 4 feet; i.e. 2 feet above the ordinary level, and 2 feet below.

In order to open a communication between Albemarle sound and the sea near Nay's Head, and keep that communication permanently navigable, it will be necessary to cut off all connexion between Albemarle sound and Pamlico, by embankments across Croatan and Roanoke sounds. The situations I have proposed for this purpose, are, from Fleetwood's fishery to Pork point, in Croatan sound, and from the east side of Roanoke Island, about 2 miles south of Ballast Point, in a line across to the banks, intersecting the Green Islands and the Horse Islands. The average depth of water, in the first of these situations, is 7 feet, except in the ship channel, which is from 10 to 15 feet. In the second, there is a channel about half a mile in width, with a depth of water from 1 to $9\frac{1}{2}$ feet, the remainder is across the islands, and the channels between them, where the depth of water does not on an average exceed 1 foot. The length of the first embankment is three miles and a quarter. The distance over the several channels of the second, amount to one mile and a quarter, and the length of embankment across the islands is 7 furlongs.

The principal reasons which induce me to recommend these situations, are—

1st. Their soundings and distances being best calculated to effect the purpose intended, at the smallest expense.

2d. They will not be exposed to the immediate action of the current; by their being situated a considerable distance therefrom.

3d. They are less exposed to the effects of storms, than any other situations which could be obtained.

4th. Their remoteness from the channel will leave spaces or bays for the reception of the eddy waters caused by the confliction of the sea and fresh waters, and where the particles of earth held in solution will subside, and in process of time accumulate, so as to become a barrier for the defence of the embankments against the effects of storms.

The principal embankment will be defended, on the south side, from any considerable reach of sea, by the marshes and islands, and on the north side it will be protected by the end of Roanoke island and Carvon's Point, being only open to north westerly winds.

The best materials for the construction of a work of this description is stone. These may be got in this State, from the neighborhood of Halifax, on the banks of the Neuse and Trent. As the transportation will be entirely by water carriage, it may be fairly presumed they can be obtained cheaper from these places than imported from any other State; and when the money expended on public works can be retained in the country or State in which they are erected, it ought always to be done, even at a small sacrifice; as it not only enriches and improves the country, but produces a spirit of enterprise in the wealthy, and a spirit of industry in the laboring class.

The dimensions I propose for the embankment of Croatan sound are as follow, viz:

The top of the embankment to be 5 feet above the ordinary height of the surface water in the Sounds; to be 15 feet wide at top, with a slope of 3 to 1 on the north side, and a slope of 2 to 1 on the south side.

For the embankment across Roanoke sound, in the navigable channel, to be 5 feet above the ordinary height of the surface of the water; 15 feet wide

at top, with a slope of 2 to 1 on both sides. The embankments in the channels between the islands to be of the same height and width at the top, with a slope on each side of $1\frac{1}{2}$ to 1, and those on the islands of a like height and width, with a slope of 1 to 1.

Since the closing of the Roanoke inlet, a deposition of soil has taken place in the former channel, to the inlet. This, as well as the bed of the new inlet, must be removed by dredging.

The sides of the new inlet must be protected by a facing of rough stone, from the bottom to 5 feet above high water, and not less than 10 feet thick. There must, likewise, a facing of stone extend from each side of the inner end of the inlet for a quarter of a mile, in opposite directions along the shore of Roanoke sound.

Should the estimate for this work, of the above materials and dimensions, exceed the sum which can be appropriated, I have submitted a plan for its construction, of

Timber and Soil.

This, I am of opinion, may be effected by two rows of piles, 20 feet apart. The piles to be of pine logs, of not less dimensions than such as would square to a foot. They are to be hewn or sawed, perfectly straight on two sides, the face and back to be left rough, with the bark upon them. These piles are to be driven quite close together, and to be connected longitudinally and transversely, by string and cross pieces, with a trenail driven through the string pieces, into every pile. The piles are to be driven as far into the bottom of the channel as possible; in no instance to be less than 6 feet. The intermediate space between the rows of piles to be filled with the most tenacious soil, which can be had on the spot, for six feet on the inside of each row; the incumbent vegetable soil of the marshes and islands, may be used for this purpose: the remainder of the space may be filled with the soil from the dredging machine.

An objection may be urged against using timber, in the construction of this work, which is, its liability to fall a prey to the worm. The waters in the Albemarle sound are too fresh, at present, for the propagation of these destructive animals; as the waters become more impregnated with salt, it is to be feared there will be some of them. Their ruinous effects may be counteracted by a sloping bank of earth or sand, with an easy inclination. The sand, &c. taken from the channel and inlet, cannot be better applied than for this purpose.

I had no apparatus, or boring tools with me, to ascertain whether the soil in the channel of the sounds is suitable for pile driving. I have, however, very little doubt of its being so. The guide-stakes for the navigation channel are generally driven in, and seem to stand well. While taking the soundings with a pole, I found the bottom occasionally of hard sand and soft mud or clay. If timber be used, trials must be made before any contract is entered into.

Whether these embankments are constructed of stone, or timber and soil, it will be necessary, while the work is in operation, to leave an opening in Croatan sound for the passage of vessels to and from Albemarle sound.

If stone materials are adopted, nothing more will be necessary than to commence the Croatan embankment at both shores, extending the work therefrom until the whole is completed.

If timber and soil are adopted, it will be advisable to construct a pier of stone on each side of the channel, and from thence proceed with the rows of piles to both shores. As the current will of course be increased in this channel, it will be proper to throw in a layer of stones between these piers, to prevent its deepening, taking care that a sufficiency of water is left for navigation purposes.

Whatever the materials are which form these embankments, it will be prudent to stop up the Roanoke sound first; the stoppage of the waters in this sound will have little effect on the current in Croatan sound. If the Croatan sound is first stopped up, there will be a very strong current to contend with in Roanoke sound, which will not only create considerable difficulty in the execution of the work, but probably wash away a part of the natural obstructions which should be taken advantage of in this part of the work.

The deepening of the channel and the opening of the inlet, must be performed by a dredging machine, worked by steam power, with an adequate number of open flat-bottomed boats, to receive the soil alongside, and carry it to the embankment or other remote situation.

Estimate for Stone Embankments.

Stone for the embankment of Croatan Sound, -	-	\$1,274,182 00
Stone for the embankment of Roanoke Sound, -	-	251,469 00
Stone for protecting the inlet, -	-	132,000 00
Dredging the channel, -	-	493,166 00
Dredging the inlet, -	-	212,666 00
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		\$2,363,483 00

Estimate of Timber and Earth Embankment.

CROATAN SOUND.

Timber for piles, string and cross pieces, -	\$40,576 00
Pile driving, -	40,392 00
Fixing string pieces and trenailing, -	13,225 00
Fixing cross pieces, -	1,575 00
Earth between the rows of piles, -	74,037 00
Earth for sloping banks, -	180,204 00
Stone for piers and embankment, -	69,816 00
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	419,825 00

ROANOAKE SOUND.

Timber for piles, string and cross pieces, -	\$18,793 00
Pile driving, -	27,720 00
Fixing string pieces and trenailing, -	9,260 00
Fixing cross pieces, -	1,050 00
Earth for embanking inside and outside of the piles, -	37,772 00
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	94,595 00

CHANNEL AND INLET.

Excavating the channel (after deducting the quantity used in the embankments,) -	-	\$ 347,211 00	
Excavating the Inlet, -	-	212,666 00	
Stone for protecting the Inlet, -	-	132,000 00	
			691,877 00
			<u>\$ 1,206,297 00</u>

RECAPITULATION.

Total for stone embankments, -	-	-	\$ 2,363,483 00
Total for timber and earth embankments, -	-	-	1,206,297 00
Difference, -	-	-	<u>\$ 1,157,186 00</u>

Having endeavored to describe the manner of constructing these embankments, and to estimate the expense thereof, the next and most important object is to show by what means the channel and inlet will be kept permanently open. The influx and reflux of the tide will considerably assist in this operation. The great source, however, to be depended upon, must be the upland waters, which empty themselves into Albemarle sound. These waters are collected from extensive portions of the States of Virginia and North Carolina. The whole surface of the following counties in Virginia, contribute to the supply of Albemarle sound, viz: Patrick, Henry, Franklin, Bedford, Pittsylvania, Halifax, Charlotte, Lunenburg, Mecklenburg, Brunswick, Greensville, Sussex, and Southampton; and a great portion of the counties of Montgomery, Botetourt, Campbell, Nottaway, Dinwiddie, Prince George, Surry, Isle of Wight, Suffolk, and Norfolk.

The whole of the waters of the following counties in the State of North Carolina, also contribute to the waters of this sound, viz: Northampton, Hertford, Bertie, Gates, Chowan, Perquimans, Pasquotank, Camden, Currituck, Tyrrel, and Washington; and a great proportion of the counties of Stokes, Rockingham, Caswell, Person, Granville, Warren, Halifax, and Martin.

The superficial extent of country affording the supply of water, is equal to an extent of seventeen thousand square miles, or ten millions, eight hundred and eighty thousand acres. The medium annual quantity of rain falling in this State may be taken at forty-eight inches. One-fourth of this being allowed for the supply of the rivers, after deducting a sufficient quantity for the extra evaporation from the surface of the sound and rivers, will yield forty millions five hundred and seventy-six thousand four hundred and thirty-eight tons, or forty-four millions nine hundred and forty-four thousand nine hundred and three cubic yards of water per day. Rating the time of the reflux current at twelve hours of the twenty-four, there will be a quantity of water, sufficient to fill the channel and inlet, passing with a current of three and one-fifth miles per hour, independent of the quantity of sea water obtained from the influx of the tide.

The width of the channel and inlet is calculated at two hundred yards, and the depth of water at ten feet.

The supply of water by rains, is more at some seasons of the year than at

others. It cannot, therefore, be considered constant and proportionate; there will, however, be the greatest quantity when it is most wanted, namely, in stormy weather.

All philosophers agree, that the quantity of water issuing from the rivers of the world, is much greater than the proportion of rain supposed to supply them. This extra quantity is said to be afforded by subterranean sources; that either something of this kind exists, or that there must be a greater proportion of the rain water pass down the channels of the rivers, is evident, when it is taken into consideration the great disproportion of land and water on the face of the globe.

The experiments of several philosophers show, there is a greater proportion of water evaporated from the surface of water, (over and above what falls on the surface,) than the proportion of rain found by experiment to go to the supply of the rivers. If this be the case, from whence is the extra water to supply the evaporation of the sea?

Before concluding this report, it may be proper to notice, that there is no appearance of any accumulation having taken place along the sea shore, near Nay's Head. There are stumps of pine and cedar trees, quite fresh, to be found within the reach of tide waters. These are rather indications of the sea having made encroachments on the banks, than otherwise.

The rise of extreme spring tides I found to be seven and a half feet, and the rise of neap tides to be five feet.

Conceiving I have discharged my duty as a Civil Engineer, in the foregoing report, it may be considered supererogation to give any opinion of the utility of this contemplated improvement, as every enlightened citizen of this State is better able to appreciate its importance to the northern part of North Carolina, and the southern part of Virginia, than I possibly can.

I cannot, however, omit mentioning, that vessels to and from the northward, would certainly effect their passages in one half the time they do at present, as those winds which are most favorable for their passage to the northward, lock them up for weeks together at the marshes. I believe it is also an incontrovertible fact, that more losses are sustained between Nay's Head and Ocracock, than on any other part of the passage from Albemarle sound to New York.

In the event of vessels being caught in a strong on-shore wind, there is no place of refuge from Cape Henry to Ocracock Inlet. Roanoke Inlet, in this point of view, would be a very great national improvement.

I regret that the present Custom House regulations prevent me from submitting a statement of the produce exported from Albemarle sound; it not being necessary for coasters to enter their cargoes, of which description of vessels the trade principally consists.

REPORT

Of the Survey of Roanoke Inlet and Sound in the State of North Carolina.

WAR DEPARTMENT, December 29th, 1820.

SIR: I have the honor to transmit to you, herewith, for the use of the Board of Public Works of North Carolina, a report of the Board of Engineers, to the Chief Engineer, upon the plans of the Civil Engineer of North Carolina, for the Internal Improvement of that State, made in compliance with a request from the Board of Public Works of North Carolina.

I have the honor to be, Sir,

With great respect,

Your obedient servant,

J. C. CALHOUN.

His Excellency the GOVERNOR of North Carolina.

NEW YORK, December 15th, 1820.

Col. W. K. ARMISTEAD,

Commander of the United States' Engineers.

SIR: In your orders of April 10th, the Board of Engineers was directed to "aid the Commissioners of the State of North Carolina, with their judgment and opinion on such points as they may request, relative to the navigation of the Inlets of Albemarle and Pamlico sounds." The Board has only very recently received the precise information on these subjects, which, (while it was unattainable by the officers of the Board, from its nature, and not within the powers of the Topographical Engineers, from their other pressing duties,) was indispensable to forming a correct opinion. A letter from James C. Johnston, Esq. one of the Board of Public Works, at Edenton, 13th November. A plan and report of Hamilton Fulton, Esq. Civil Engineer to the State of North Carolina, in reference to making a new Inlet to Albemarle Sound, near the place of the Old Roanoke Inlet. A report of Mr. Fulton, "on the swashes, and other obstructions at Ocracock Inlet." And a report of the same gentleman, "on the removal of a shoal below the town of Washington," all dated September, 15th; make up, with the examination made by the members of the Board of Engineers themselves, the information on which we found the following remarks; which remarks are submitted, respectfully, through you, to the Board of Public Works of the State of North Carolina. The authorities above enumerated are appended.

REMARKS,

"On the practicability of opening a communication from Albemarle Sound to the Atlantic Ocean."

1. Can the project be executed? And, if so, will the passage remain unaffected, seriously, by storms and currents?

Mr. Fulton proposes to extend a dam across Roanoke, and another across Croatan sound; (see Mr. Fulton's plans and reports, p. 16, 17:) the reasons he gives for preferring the places chosen, are substantial; but it may be observed, in relation to deposition in the bays which will be formed by the dikes, that without considering the confliction of the sea and fresh waters,

there will be eddy waters in these bays, both upon the ebb and the flood, from the well known operations which produce them in all indentations from the line of the current of rivers; and where these eddy waters are, there must be a deposition in all rivers flowing through such a soil as that of North Carolina. There is, then, good reason to believe, that if the embankments are once made with sufficient solidity to resist the effects of the first violent storms, each succeeding year will contribute to their stability; and that time, who infallibly destroys most of the works of man, will here become an auxiliary of transcendent power.

As to the materials, and plan of construction, of these embankments, the first design of Mr. Fulton, (see page 17) seems almost without fault, in all that regards certainty of execution, and security when completed, without, as well as we can judge, any excess of strength. We hope it will not be without advantage, however, to observe, that the dike across Croaton will be exposed to a reach of north-west wind (down the Pasquotank and across the sound) of thirty miles: north-west winds frequently occur during the winter, and are often, for many successive days, of great violence; there must be, during these gales, a great accumulation of water upon the northern side of the dike, while upon the south side there will be an unusual depression; considering the reach of wind and water, it may be supposed that the sea will act with great force against the obstruction, and that the agitation of the surface within the bay, by the wind, will be much increased by an opposing current, which will be caused by the effort of the embayed waters to regain their level in Albemarle sound: the sea will be received at its maximum elevation by the dike, over which it will pass, with a considerable fall, into the lower waters on the southern side; the superior layer of stones will lose much of their stability by being covered with water—and if their surfaces, which will receive the shock of the sea, should bear a great proportion to their specific gravity, they will be liable to be removed to the leeward side of the embankment. The only precaution necessary, in view of this danger, is to employ, for the upper strata, stones of great weight.

As it respects the second plan of Mr. Fulton, (see page 18) an embankment of “timber and soil,” on the same principles that we have supposed it necessary to use stones of great dimensions to compose the superior surface of the stone dike, we think that earth alone will not suffice as a covering. The pitching of the waves upon the top, and the overfall, it appears to us, will certainly scoop out the earth from between the piles, and carry it to leeward. No means of obviating this objection occurs to us, unless the earth between the piles may be so compacted as to sustain, without an injurious subsidence, a layer of large stones.

It is proposed to make the Roanoke dike first: the reasons given by Mr. Fulton (see page 19) show clearly the propriety of this course.

It is proposed to cut the new inlet a little to the south of Nay's Head, to make the inlet and the channel though the shoals of Roanoke Sound, two hundred yards wide and ten feet deep, and to sustain the sides of the inlet by rebutments of masonry. (See plan.) The calculations by Mr. Fulton (which we are disposed to believe are as accurate as the subject under investigation will admit, see pages 20, 21,) of the waters to be discharged at this issue during the twelve hours of ebb, give a sufficiency to keep the inlet and channel full, and to preserve a current of three and one-fifth miles per hour, independent of the water which will be received into the estuary during the flood from the sea. This calculation, we presume, supposes the *ordinary* supply

of water by rains, the *common* level of the sound, and the *neap* tides of the ocean; because it is only by thus considering these elements of the calculation, that the *mean* quantity and velocity can be ascertained; and, the question being the usefulness of the result, a mean only, in this case, where essential variations are of rare occurrence, is admissible. We also presume that this velocity of $3\frac{1}{2}$ miles per hour, (or 56.32 inches per second,) is a mean between the top and bottom velocities; and we deduce, by our mode of calculation, a velocity at the *bottom* of the current, of 48.8 inches per second.

Now a bottom velocity of 36 inches per second is known to be sufficient to move angular and coarse gravel. What then will be the effect of a velocity of 48 inches upon the mud and light sand over which this current is to pass? And, above all, what will be the consequences, when an accumulation of waters, by a continued westerly wind, shall conspire with low water of spring tide to increase the stream much beyond this estimate of 48 inches?*

We come now to the consideration of a matter, which, though it will oppose no obstacles to the execution of the scheme, may ultimately seriously diminish its usefulness: we mean the possibility that a bar may be formed in the ocean, opposite the mouth of the inlet, which will prevent access to the inlet to vessels of the proper draught of water. If it be true that the velocity will be great enough, at certain places within the estuary, and for a certain time, to put the sand and mud of the bottom in motion, it cannot be doubted that, during the existence of this current, a vast quantity of these substances will be deposited near that point in the ocean at which this current shall be counterpoised by returning tides, and by an opposing swell. It would be tedious, and it is unnecessary, to follow all the steps of such a formation; the causes are obvious, and the effects are to be found at the mouth of every river, whose waters carry with them to the sea the proper materials. Though the first deposition will be very great, it is not probable, because of the great depth of the ocean near the proposed cut, that it will obstruct the navigation; and it may be many years before the matter brought down by the waters will raise the bar to an injurious height; but the day must ultimately arrive when the Nay's Head inlet will have all the imperfections of its neighboring issues; and whether it will then rank with the best or worst of them, no human foresight can determine.

We add, that it appears to us of no little consequence, before going into the execution of the project, to ascertain with certainty that the waters of Albemarle sound cannot force a passage towards Ocracock, through the swampy grounds and creeks which lie (according to the map of the State) to the west of Croatan: and in coming to a conclusion on this subject, it should be remembered that the waters are to have an issue very contracted, compared with the present one, and will therefore be raised under certain circumstances, in this part of the sound, to a greater height.

2. *What will be the expense?*

Mr. Fulton, for the stone embankment proposed by him, (see p. 19) finds an expense of \$2,363,483; and for that of earth and timber \$1,206,297. It occurs to us, that clearing out the channel and inlet, unless it be thought improper to give thus much towards the formation of a bar, may be chiefly committed to the current, especially if advantage be taken of a moment of greatest elevation within and depression without.

3. *Will the advantages resulting to the State, be equivalent to the expenses?*

* It seems to us to follow, as an inevitable consequence, that this current will deepen, and, where not confined by walls, will widen the channel and inlet until the *velocity* along the bottom and sides is reduced to an exact equilibrium with the *tenacity* of the bottom and sides.

If the design can be proved practicable, and of permanent utility, the propriety of its abandonment or of its completion will depend, chiefly, as respects the State, on the answer to this question. Desirous as we are to aid in the solution of this important question, it is one so involved by the particular interests of the State, with which we are not at all conversant, and by a species of commerce not submitted to registry, and of the value of which we can make no estimate, that we find ourselves unable to offer any assistance. It is certain, however, that the observation of Mr. Fulton, (see p. 22,) on the greater safety from shipwreck, and the economy of time which will result to the commerce of Albemarle Sound, points out advantages which deserve to be highly valued.

4. *How will the execution of this project affect the interests of the Union?*

Without entering into an examination of the political effects of the proposition which has come under our consideration, and in which the particular interests of the State may possibly run counter to those of the Union—an examination to which we do not consider ourselves called by our instructions, nor qualified by due preparation—we shall merely remark, that if the plan be carried into successful execution, whether we consider the profits of commerce, the dangers of shipwreck, pursuit by an enemy, or convenience as a point of departure and refreshment, for our own privateers and vessels of war, a harbor will be formed precisely in that part of the coast where it is most needed.

The only other improvements in navigation, contemplated by the State of North Carolina, of which we have been informed, are, *deepening the channels at Ocracock*, and *removing a shoal below the town of Washington*. We are not prepared to say any thing on these subjects, more than that the designs of Mr. Fulton, (see his reports,) seem well adapted to the nature and situations of the obstructions, and that no means occur to us by which the objects in view can be attained with more certainty or without greater expense.

S. BERNARD, *Brigadier General.*

C. GRATIOT, *Lieut. Col. of Engineers.*

JOSEPH G. TOTTEN, *Major Engineers.*

Brevet Lieut. Colonel.

OBSERVATIONS

On the remarks of the Board of United States Engineers, relative to a report on the practicability of opening a communication from Albemarle Sound to the Atlantic Ocean, to the President and Directors of the Board for the Internal Improvement of North Carolina, by

HAMILTON FULTON,

State Engineer.

Raleigh, April 21st, 1821.

GENTLEMEN: I have lately had the honor of receiving from the Secretary of your Board, the remarks of General Bernard, Col. Gratiot, and Major Totten, composing the Board of U. S. Engineers, on my report of last year, for opening an inlet at Roanoke Sound.

It is extremely gratifying to find, that gentlemen of such eminent rank and talents, coincide with me, generally, as to the practicability of effect-

ing this great and important object. There are however, a few points on which some difference of opinion exists, and upon these points I am induced to offer the following observations.

The Board of Engineers seem apprehensive, that the superstructure of the stone embankment in Croatan sound may, if not composed of "stones of great weight," sustain some damage in northwesterly gales, from the elevation of the waters on the north side, the depression of the waters on the south side, and the washing of the waves over the whole. Conceiving it extends a general report to too great a length to enter into a detail of the disposition and dimensions of materials, I have been in the practice of postponing that part of my professional duty, until the time when the work is offered to contractors; at which time, I trust, specifications will be made out, for the construction of the work, in a manner which will resist the effects of the strongest gales.

From the same causes, those gentlemen suppose the soil between the piles of the timber embankment is likely to be scooped out by the washing of the waves over it. I think it is very probable the sea will wash over the stone embankment, by its having sloping sides from the bottom to the top; but it does not appear to me the same effect will be produced by the action of the waves on the timber and soil embankment, which is to have sloping sides of earth from the bottom to the ordinary surface of the water; from thence is to be a vertical face of piles, five feet in height, which I am inclined to think, from the observations stated below, is sufficiently high: for, according to the law of reflection, which requires that the reflected wave should take such a direction as to form an angle with the surface, equal to that which the incident wave formed with it, I do not apprehend there will be any risk from the washing over of any part of the wave, except the light spray; and should it be found, during the execution of the work, that the spray washes away any of the sand in the middle of the embankment, the whole may be covered with a stratum of marsh turf, similar to that which it is proposed to line the inside of the piles with. This soil is of a very flaccid consistency, and will, in the course of a season, form a sward impervious by the spray.

The observations above alluded to, are those I made of the effects of gales of wind which happened during my stay at Roanoke Island. On the 14th of March, 1820, there was a very violent southwesterly gale, the effects of which I noted at several places. In a ditch connected with Croatan sound, and into which the waters flowed freely, but where there was little agitation, I found the extreme rise did not exceed two feet. In another situation, where the Sound waters have an opportunity of showing their most violent effects, the perpendicular height of the extreme wash was only three feet nine inches. By a reference to the section of the bank, where the inlet is proposed to be cut, it will be seen that the ordinary height of the spring tides reaches within four feet ten inches of the top of the bank. These banks are exposed to the whole reach and swell of the Atlantic: and I am not aware of the sea waters ever having run into the Sound, in the most tempestuous weather, since the closing of the Inlet.

Southwesterly winds, in the present state of the Sounds, produce the greatest elevation of the waters. After the embankments are made, winds from west to northwest, will have the effect of depressing the waters at the upper end of Albemarle sound, and of heaping them up at the lower end, if the outfall is not capacious enough to admit of their escape. All winds

which have a tendency to raise the waters at the lower end of the Sound, will depress the waters of the Atlantic, and thereby accelerate the egress of the Sound waters.

The calculations of the Board of Engineers, with regard to the velocity of the waters issuing through the proposed inlet, are perfectly correct; and they are also correct in stating, that the result of experiments which have been made, show that a velocity of 36 inches per second, will move angular and coarse gravel (*of the size of a hen's egg.*) These experiments refer to currents which flow constantly in one direction; and although apparently there is little else to contend with at Nay's Head than sand of a fine quality, yet I do not think I should have been justified in extending the size of the inlet, so as to reduce the current to the rate which it is calculated will remove either sand or gravel of the above dimensions. It is probable there will be depositions of large masses of concrete oyster shells, saturated logs, roots, &c. to contend with; there will be shells washed in by the influx tide, and a deposition of alluvion and other materials at the period of slack water. The breast-work of large loose stones, which it is proposed to lay along the sloping bank of the inlet, and for some distance along the shore of the Sound, will, in my opinion, effectually prevent its increasing in width; and if it should wash to a greater depth than ten feet, nothing is to be dreaded from it but the undermining of the breast-work, which, being composed of loose stones, laid on the bank at a small angle with the horizon, will, if the foundation be sapped, follow it without injuring the whole.

I cordially concur with the opinion of those gentlemen, "that this current will deepen, and, where not confined by walls, will widen the channel and inlet, until the velocity along the bottom and sides is reduced to an equilibrium with the tenacity of the bottom and sides;" but so long as the quality of the materials which will present themselves to the current of the waters remains a desideratum, so long shall I feel warranted in recommending the inlet to be made of the width at first proposed; it being less difficult and expensive to widen than to contract it.

The contracted width of the inlet, and the consequent velocity, will have the effect of carrying the alluvion to a greater distance from the shore than if it were more extended; and if it is a fact that a current set to the south with a drift of one knot an hour, there is every reason to conclude that this southerly current will sweep away the particles held in solution by the effluent waters of the inlet. None of the recent surveys of, or observations on the coast of North Carolina, extend further than a few miles to the northward of Cape Hatteras; I have, therefore, no other authority for the existence of such a current than the observation (stated in my last report,) taken from Wimble's map.

I was induced to believe, from the configuration of the whole coast of North Carolina, and the accumulating shoals of the Capes, that a southerly current did exist; but an observation on Captain Elliott's chart, in which he says, "the current in soundings is entirely influenced by the wind, averaging $1\frac{1}{2}$ mile per hour," has rather staggered my opinion on the subject. As this remark occurs only once on the chart, (near the Frying Pan Shoals,) perhaps it does not refer to the whole coast. The indentations on the coast, which form segments of circles, give strong indications of an eddy current from the Gulf Stream; and if such a current does exist along the northern part of the shore of this State, it seems probable that it will be accelerated by the discharge of the Chesapeake waters.

There are no swamps or creeks, to my knowledge, by which it would be possible for the waters of Albemarle sound to force a passage into Pamlico sound. The embankments in Croatan and Roanoke sounds abut against lands upon which the waters have no effect at present, and unless the improvements cause a permanent and unusual elevation, nothing is to be apprehended of such a junction taking place. I have been told, but from authority on which I did not place any reliance, that it was possible to carry a canoe from the Alligator river into Pamlico sound, by some of the creeks in the interior; and it appears from Price and Strother's map, that some of the tributary streams of the Alligator and Pungo rivers flow from the same reservoir, (Alligator lake.)

My reason for proposing to clear out a channel in the Sound, and to clear out the greater part of the inlet, is, that a channel may be secured in a proper direction, and that the works connected with the inlet may be nearly completed before the sea waters are admitted.

WASHINGTON, *February 12th*, 1829.

Col. C. GRATIOT, *Chief of Engineers.*

SIR: I have the honor to report the result of the operations, called for by the instructions of the Board of Engineers, prepared by order of the Engineer Department, and predicated upon the act of Congress of May 20th, 1826, requiring "a survey of Roanoke Inlet and Sound, with a view of ascertaining the practicability of making a permanent ship channel between Albemarle Sound and the Atlantic Ocean, at Roanoke Inlet, or elsewhere, and a statement of the cost of effecting this object."

In explanation of the delay attending the presentation of this report, it may not be deemed improper to remark, that because of the survey already enjoined upon the members of the corps, the instructions above referred to, and which called for other surveys under the same act, already reported upon, were only received in January, 1827, and that in consequence of duties subsequently imposed upon the party under my direction, the surveys, &c. now under consideration, were not completed until the close of January, 1828, since which time the party has been, for the most part, actively engaged in the duties of the field.

It is impossible to enter upon the discussion of the proposed project, involving such important consequences to the populous and productive portion of the country watered by the Roanoke river, without feeling deeply sensible of the difficulties in effecting so desirable an object, and the degree of uncertainty attending the result of any operations, where the causes to be governed are so infinite and powerful. This is apparent even to the most unpractised in the profession of engineering, wherever the course of nature in her marine operations is to be governed. Indeed, there is probably no subject within the range of the science, where so much is deduced from hypothesis, and where necessarily in the result there is so little certainty. Nor can we, from the cases already put into practice, adduce the evidence of the success of any series of operations, having in view such improvements, inasmuch as almost every case is of a new character. This would appear to be the fact, when we bear in mind, that probably in no one instance, where operations have been carried on for the improvement of harbors, inlets, &c. have the results met the expectations entertained.

In expressing these opinions, I am impelled only by the desire of impressing upon the conviction of the sanguine, the difficulties which belong to hydrographical improvements, without particular reference to the subject of this report.

That there was originally an inlet at Roanoke, admits of no doubt. Indeed, if the fact could not be established as a matter of history, we have the evidence of those now living for the truth of such an opinion. But in "the History of Carolina, by John Lawson, Gentleman Surveyor General of North Carolina," London, 1709, we have, page 61, a general description of the coast, in the following words: "This part of *Carolina* is faced with a chain of sand-banks, which defends it from the violence and insults of the *Atlantic* Ocean; by which barrier a vast sound is hemmed in, which fronts the mouths of the navigable and pleasant rivers of this fertile country, and into which they disgorge themselves. Through the same are inlets of several depths of water. Some of their channels admit only of sloops, brigantines, small barks, and ketches; and such are *Currituc*, *Roanoke*, and up the sound above *Hatteras*. Whilst others can receive ships of burden, as *Ocracock*, *Topsail Inlet*, and *Cape Fair*, as appears by my chart." This chart is dated 1709. Here, then, as far back as the early part of the 18th century, we are told of the existence of an inlet at Roanoke, capable of receiving "sloops, brigantines, small barks, and ketches." But, moreover, we have in the same work, a particular description of each of the inlets, at that period connecting the sounds of North Carolina with the ocean; namely, Currituck, Roanoke, Hatteras, Ocracock, and Old Topsail Inlets. Of these, Currituck, Old Topsail, and Ocracock still exist, and at this time essentially answer the description of the above-named author. This remark, however, applies more particularly to Old Topsail Inlet; and to show what degree of credence should be given to the same writer's account of Roanoke, as it existed in his time, I will, previously to quoting his notice of that inlet, copy his account of Old Topsail, page 65. "*Topsail Inlet* is above two leagues to the westward of *Cape Look-Out*. You have a fair channel over the bar, and two fathom thereon, and a good harbor in five or six fathom to come to an anchor. Your course over the bar is almost N. W. Lat. 34° 44'." These remarks, written in 1701, apply generally at this moment to that inlet. We may, then, reasonably conclude, that those of Roanoke inlet were equally correct. Page 64, "*Roanoke* inlet has ten foot water; the course over the bar is almost west, which leads you through the best of the channel. This bar, as well as *Currituck*, often shifts by the violence of the north-east storms, both lying exposed to these winds. Notwithstanding which, a considerable trade might be carried on, provided there was a pilot to bring them in; for it lies convenient for a large part of this colony, whose product would very easily allow of that charge, lat. 35° 50'."

The fact of the existence of an inlet at Roanoke, for vessels of a limited draught of water, being established, the question immediately presents itself as to the causes which tended to its destruction; for it is necessary in the consideration of a subject, having in view the re-establishment of the original state of things, to be apprized of the causes leading to such change. These causes consist, it is believed, for the most part, in the evident changes which have taken place in the topography of the adjacent country, giving to Albemarle sound a continual increasing vent to its waters, which originally passed by the inlet in question. Reference is here made to the increasing size of the numerous passages through the marshes between Roanoke island and the Croatan shore, and which induced a corresponding diminution of the in-

let, until it finally closed. That these passages have increased, and by such increase given to the sounds greater facilities of discharging from one to the other, the accumulated waters caused in each by the influence of the winds, and particularly of Albemarle sound, is evident by an inspection of the original maps of that section of the country, if we had not the conclusive testimony of the elder inhabitants, who distinctly recollect the very limited size of the passages alluded to.

The deduction, then, appears reasonable, that, if the instance of the inlet depended upon the contingency of the waters of Albemarle sound finding an outlet to the ocean by that single passage—and it would seem such a position cannot be doubted—that when another was created, which, by continual natural causes, was increasing in its ability to perform those functions, that inlet proportionally diminished in size, until it finally closed up. That it should have proceeded south, during its decrease, to its extinction, will be readily accounted for in the continual diminution of the volume of water passing through it to the ocean, in connexion with the presence of a southerly current on the outside, and the unremitting tendency of the ocean to throw up a continuous sand-bank upon our southern coast.

If, then, in the opinions just cited, we have enumerated the causes which have operated in closing up the inlet, it is reasonable to predict that, by reinstating the original character of the topography of the country, or in other words, by limiting the means, now possessed by the sound, in getting rid of its surplus waters, to the single passage over the narrow strip of sand between it and the sea, that nature, assisted in the first instance by the efforts of man, would give the desired result. It was undoubtedly upon this course of reasoning that the Engineer of North Carolina rested the feasibility of his project of closing Roanoke and Croatan sounds, and which met the entire approbation of the Board of Engineers.

If, indeed, the position just advanced is tenable, that confining the waters to this single outlet to the ocean, must ensure the presence of such a communication, and one offering facilities proportional to the volume of water passing through it, then we have a right to anticipate, as a consequence of the fulfilment of the project, even a better navigation than originally belonged to that inlet, when the passages between the sounds, though limited in size, still existed, as is shown by the earliest writers, who invariably speak of Roanoke as an island. But this deduction, beyond a certain limit, will not always hold good. For though the inlet and its permanency depend on the passage through it of a certain quantity of water, and which we may infer did pass through Roanoke, when its capacity and situation were fixed, we cannot conclude, therefore, that when the volume is increased beyond such quantity, and that required for its actual existence, that it would afford a proportional depth and facility to navigation; and the reason is obvious, and is based upon the rationale of the formation of such obstructions, whose position, as a consequence of the increased velocity of the current, would be merely changed, and which in the instances of Ocracock and Roanoke, should be greatly deprecated, as throwing the shoals further into the sounds.

But supposing the project, which, from its nature is somewhat problematical, should be entirely successful in restoring the inlet to its original state,—and none but the most visionary could entertain a hope of a more beneficial result,—the question for consideration occurs as to the propriety of involving an expenditure to the amount required for the accomplishment of the plan under consideration. To determine this, we must revert to the authorities which speak of the capacity of the inlet in the early settlement of that part

of the coast. Lawson, who wrote in 1701, says it could "admit only sloops, brigantines, small barks, and ketches;" and in his particular account of the inlet, remarks that "Roanoke Inlet has ten foot water; the course over the bar is almost west, which leads you through the best of the channel." This depth is evidently intended for the quantity of water on the bar, and not in the sound, where, as in all similar situations, being effected by the same causes, the draught must be less. This opinion is supported by an examination of a map of later date, 1738, by Wimble, which, although it gives 9 feet on the bar, shows but 6 feet in the sound, and which, in the course of trade, necessarily limited the vessels engaged in it to that draught. Wimble also, by his chart of that coast, shows the comparative capacities of the inlets, representing Roanoke as capable only of receiving sloops, whereas ships could enter the Cape Fear and Old Topsail, and brigs into Ocracock. These two authors may be generally depended upon. The information derived from other sources, and anterior to them, is however so very vague, in consequence of the changes in the names of the different places, which cannot be identified because of the inaccuracy of the maps of that period, that it is not to be relied on. But already enough has been proved for our purpose; and it is not necessary that we should give examples in return, to establish the truth of a more limited draught in the sounds in such cases. For the causes which give to the navigation at Ocracock, the only inlet to which it may be assimilated, so limited a depth, will all be present at Roanoke upon the opening of an inlet at that place. The influx of the tide, and its subsidence in the expanse of the sound, in which there are only leeward tides, after having, during its greatest velocity, taken up large quantities of sand, &c., must inevitably give the same general results, governed, of course, by the minor local causes which belong to each individual situation.

The question then presents itself, whether the advantages derived from a navigation so limited, warrant an expenditure necessary to the execution of the proposed project, supposing indeed it should have the full effect for which it was intended. The decision of this question belongs, however, more properly to the political economist than to the engineer, whose duty only is to decide upon the most feasible plan, combining usefulness with stability.

That the subject may be now presented in one view, the report of the Engineer of North Carolina, with the approbatory notice of the Board of Engineers, and his remarks thereon, are herewith transmitted. Nothing in the result of the late surveys and observations, going in any degree to invalidate the correctness of the grounds there assumed by the high authority just quoted, and which would seem to put at rest any doubt as to the practicability of effecting an object of more extensive usefulness, probably, in a local as well as national point of view, than any other work of a similar character in our country. The fears entertained by the Board, as to the probability of the waters of Albemarle finding new passages across the low grounds west of Croatan, to Pamlico sound, it is believed, have no foundation: inasmuch as the winds which cause the greatest raise of the water at Roanoke island, do not affect materially the height of the water in Alligator river, by which and its head branches, approaching Mattimuskeet lake, could such a communication be formed. The extent of the land to be traversed, in every instance, making it highly improbable a connexion should take place in any other direction.

In expressing a general concurrence in the correctness of the views taken by the Engineer of North Carolina in regard to the contemplated improve-

ment, the opinion is respectfully dissented from, that "nothing is to be dreaded from it, (the washing of the channel across the sands to a greater depth than 10 feet,) but the undermining of the breastwork, which being composed of loose stones on the bank at a small angle with the horizon, will, if the foundation be sapped, follow it without injuring the whole," for it would seem by such an event the intention—in the protection of the sides of the cut from the abrasion of the current—for which it was lined, would be defeated. Besides, it is very problematical, whether the stone in question would not, after slipping into the channel, disappear entirely, during the presence of one of those violent gales so frequently experienced upon that coast, where from causes not satisfactorily explained, the sands, by being exposed probably to the passage of a rapid current, at a moment when the waters of the ocean are heaped up on the coast, and depressed on the sound side, have no longer the same power to sustain bodies whose specific gravity is so great. The storm, for instance, at North Inlet, S. C. in 1822, may be cited; when the masonry of such houses as were exposed to the inundation was swallowed up in the sands.

The foregoing observations lead to the following conclusions:

1st. That Roanoke Inlet existed from the time of the earliest settlement of the country, to its final closing, within a few years.

2d. That, although its capacity for entrance might have been good, yet, in consequence of the limited depth of water within the sound, its usefulness was confined to vessels of a light draught.

3d. That its gradual filling up and final disappearance was in consequence of the continual increasing vent given to the waters of the sound, because of the washing away of the "marshes" near Roanoke Island.

4th. That if, in the foregoing, the proper reasons have been assigned for such a result, the plan proposed, by restoring the original state of the topography of the country, thereby forcing the surplus waters of the sound to pass directly to sea, aided in the first instance by art, would give a result corresponding to its original state.

5th. That because of the presence of the same causes which gave to the inner navigation at Ocracock so limited a depth, we cannot hope for the creation of an Inlet at Roanoke, which would better subserve the interests of the upper country, excepting by its directness, than exists at the former place.

6th. That no human foresight can predict the precise result of any operations of a similar character, when the causes to be governed, when known, are so various and powerful; and

7th. The plan being feasible, whether the cost in carrying it into effect should be incurred, when the most successful result would give, comparatively with the expenditure, so limited a benefit.

If it were not for the question of probability, connected with the consideration of the last deduction, we could at once institute a calculation of dollars and cents, to determine the propriety of its execution. Unfortunately, in the present instance, this cannot be done; and the enormous amount of the cost of effecting the object, joined with a degree of doubt which hangs about the result of every operation of a similar nature, renders it highly probable it may never be carried into effect. With this strong conviction, and feelingly alive to the grievous impediments now existing to the commerce of that portion of our country, it is the intention to propose another plan, which, though it is liable in some degree to the same objections, and may not meet the wishes of the sanguine, will, however, take away, in a great measure, from the many disadvantages under which the navigation in question now labors.

I am the more disposed to recommend it, inasmuch as most of the details, if ineffectual in the execution, make up in part the plan of the Engineer of N. Carolina, already described.

The general features of the plan now presented for consideration, are, the excavation of a channel through the shoal ground in the sound, cutting across the sands between it and the sea, and, by the intervention of a tide lock, secure to the trade an outward navigation at all times between half tide and high water. In submitting this plan, we must regret the entire impracticability of giving to the import trade the benefits of the same channel. This will be evident at once in the smallness of the sea mouth of the cut, thereby causing great risk in attempting its entrance, with a lee-shore—as it must always prove in the immediate vicinity of a cape—the most dangerous, with one exception, of our extended coast, without the protection of a breakwater in case of unfavorable weather. The hopelessness of combining such an auxiliary, however, is most conclusive, when we reflect upon the unremitting tendency of the currents of the ocean on the southern coast, and the abundance of the elements which go into the formation of the shoals, and which in this instance would endanger the safety, if not, indeed, the very existence of the proposed inlet.

The reasons for the adoption of the plan now proposed, are—

1st. The comparatively small expense attending its execution.

2d. That although its benefits will be confined to the export trade, to successfully prosecute which requires greater draught and despatch, yet, in consequence of the absence of the current of the tide, in the still water of the sound, a navigation of greater depth may be maintained; and

3d. That in case the plan should, in the execution, be found not to answer the ends intended, the measures in its adoption, with one exception of the tide lock, make up in part the project connected with the stoppage of the sound, and which might then be adopted as a dernier resort.

The disadvantages under which the plan labors, compared with that detailed in the first part of this report, consist—

1st. In the absence of a channel, by the contemplated plan, for the return trade; which is, however, greatly counterbalanced by the greater draught and despatch given to the outward bound; and

2d. In the want of a harbor, though limited in depth, as a place of refuge in case of “danger of shipwreck, pursuit by an enemy, or convenience as a point of departure and refreshment for our own privateers and vessels of war.”

Having already shown that the inlet was closed, in consequence of the decrease of the water issuing from it, and the presence of a southerly current, in connexion with the invariable tendency of the sea; it may be asked in what manner it is proposed to keep open the mouth of the cut, during the presence of these causes, when the waters or tides, because of the tide lock, have neither ingress or egress? Before answering the question, it should be borne in mind, that the draught of water in similar situations with those of Ocracock and Roanoke, is much less upon the inner than the sea side. As the principles governing such a result are explained at large in the report on the obstructions at Ocracock, it is not thought necessary to dilate upon them here. It is enough, that such is the admitted fact, to show the efficiency of such a plan, as will ensure all the benefits which belong to the passage of the water to the sea, in the one case, without the injurious effects in its return as a current, to the sound, in the other. This will be easily understood by an inspection of the profile appended to the map: by which it

will be seen that the ordinary level of the sound is mid-way between the high and low water of the ocean, and that, taking advantage of the low water, at sea, and a calm state of the weather, and opening the gates of the lock, by a rush of water through the cut, remove such deposit as the unceasing disposition of the sea may have created during the preceding rise and fall of the tide. It is not intended to infer, from the means thus employed, there would be an entire absence of the obstructions common to every inlet of the South. The very power which keeps them open, contains within itself the elements of such formations. Nor can we foresee the form or extent of the obstructions so created. It is not, however, at all probable, they will, in this instance, prove so great as to debar the free exit of all vessels, whose draught will allow of the passage of the lock itself, which would have been recommended for the passage of vessels at any time of the tide, but that the cut can be used only by the outward bound trade.

The calculations for excavations in the sound, are made for a channel of 10 feet deep, and for a minimum width of 300, which may, if found too narrow, and the project prove successful, be increased at a proportional expense. The general principles, showing the necessity of protecting the inlet, in the project of the Engineer of North Carolina, are applicable to the present plan. It is however recommended, to give this protection both to the bottom as well as the sides of the cut, and instead of merely throwing the stone, to lay it as a dry wall; this is preferred, not only on the score of durability but for the sake of economy, the cost of the stone necessary for the fulfilment of the other plan being more than double. The precise cost of a lock of the dimensions required for the passage of sea vessels, and constructed under the influence of the pump, is not given, for the want of the time necessary for the collection of the proper data. The gross amount, however, shown in the general estimate, is thought fully sufficient to cover the expenditure under that head.

The present opportunity is eagerly embraced, to do justice to the industry and zeal evinced by Lieut. W. M. Boyce and the late Lieut. S. Wragg, in the execution of the surveys and observations necessary to the fulfilment of the act of Congress, already referred to in this report.

I have the honor to be, Sir,

Your obedient servant,

(Signed)

HARTMAN BACHE,
Captain Topographical Engineers.

(No 1.)

Estimate shewing the first cost of a dredging machine, steam engine, scows, &c, complete, and the current expenses of the same for one year:

Purchase of a vessel	-	-	-	-	\$ 6,000 00
Purchase of a steam engine of 8 horse power	-	-	-	-	2,800 00
Purchase of 4 receiving scows, at \$ 450 each	-	-	-	-	1,800 00

Cost of one machine, &c. complete	do	-	do	-	\$ 10,600 00
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Pay of a superintendent at \$ 75 per month, for one year	-	\$ 900 00
Pay of a steam engineer	30 do - do	- 360 00
Pay of 4 hands	- 15 do - each	- 720 00
Pay of 6 hands	- 12 do - -	- 864 00
Subsistence 12	- 6 do - -	- 864 00

Purchase of 437½ cords of wood, for engine, for one year of 250 working days, at \$ 3 per cord	-	-	-	1,312 50
Repairs of engine, &c. and contingencies	-	:	-	600 00
Current expenses of a dredging machine for one year	-	-	-	<u>\$ 5,620 50</u>

(Signed)

HARTMAN BACHE,
Captain Topographical Engineers.

(No 2.)

Estimate of the cost of clearing out the proposed channel in Roanoke sound, 300 feet wide, for a draught of 10 feet at the common stage of the water; supposing six dredging machines be employed for that purpose and that each will lift 257 cubic yards of deposite, every working day of 10 hours, estimated at 250 in the year.

First cost of six dredging machines complete, at \$ 10,600 each: see No. 1. - - - - - \$ 63,600 00

Current expenses of the same for 2 years and 106 days, or 573 working days, the time required for the removal of 859,762 cubic yards, at \$ 5,620 50 each per year, see No 1., or \$12,873 25 each machine, to the completion of the excavation - - - - - 77,239 50

Total cost of excavating the channel in Roanoke sound - \$ 140,839 50

(Signed)

HARTMAN BACHE,
Captain Topographical Engineer and

(No 3.)

Estimate of the cost of the cut through the banks between the Roanoke sound and the ocean, including lining, &c. for a depth of 10 feet below the common level of the sound.

Excavation of 25,584 cubic yards of sand, &c. above the level of high water, at 15 cts. per cubic yard, - - - \$ 3,837 60

Excavation of 69,553 cubic yards of sand, &c. below the level of high water, at 50 cts. per cubic yard, - - - 34,776 50

Purchase of 44,480 perches of stone, to line the cut including the bottom, five feet thick; to the height of storm tides, or 2½ feet above ordinary high tide. The wall to be 10 feet thick at bottom, and 5 at top, at \$ 5 per perch, 222,400 00

To lay the same as a dry wall, at \$1 50 per perch, including scowing, pumping, &c. - - - - - 66,720 00

Total cost of the cut, - - - - - 327,734 10

(Signed)

HARTMAN BACHE,
Captain Topographical Engineers.



